Tri-Color Optical Filter Manual

Revision 1.00

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Quick Start Guide

Requires a computer running Microsoft® Windows® XP or later.

1) Place the included CD in the CD-ROM drive, wait for the ColorDRIVE menu to appear and click on the "Install ColorDRIVE …" button.

2) The USB driver will need to be installed prior to connecting the controller to the computer. The ColorDRIVE menu has an option to install the drivers. Otherwise, the driver installers are on the ColorDRIVE CD in the following directories:
   32 bit Windows® XP & newer: USB DRIVERS\32 bit\
   64 bit Windows® Vista & newer: USB DRIVERS\64 bit\

3) Plug the USB cable into the appropriate connector on the digital interface controller. Plug the other end into an appropriate USB port on the computer.

4) Connect the cable from the Tri-Color filter optics head to the Tri-Color Filter controller.

5) Plug the power supply into the appropriate connector on the controller back panel. Connect the power to a properly grounded outlet. Please note that the Tri-Color Filter is capable of being USB powered.

6) Turn on the controller power. The LED in the switch will illuminate YELLOW initially, and then flash the firmware version in GREEN, followed by a steady GREEN. Please note that the previous Tri-Color Filter settings are automatically used until changed by the user.

7) Start the ColorDRIVE software by clicking Start ➔ All Programs ➔ Meadowlark Optics ➔ ColorDRIVE➔ ColorDRIVE.

8) Once the unit has been configured, it can be placed in autonomous mode, where it will output the configured waveforms even when disconnected from the computer. Please note that when using this mode, the external power supply must be used.

   -If the filter is powered off and then powered on, it will use the previously programmed configuration.

Power Supply

(Required if using autonomous mode; otherwise the controller may be USB powered.)

Power Supply

Tri-Color Filter Head

Personal Computer

USB

Tri-Color Filter Controller

Function Generator Or Trigger Source

I/O Connectors (for external equipment Interface.)

Equipment needing sync pulse
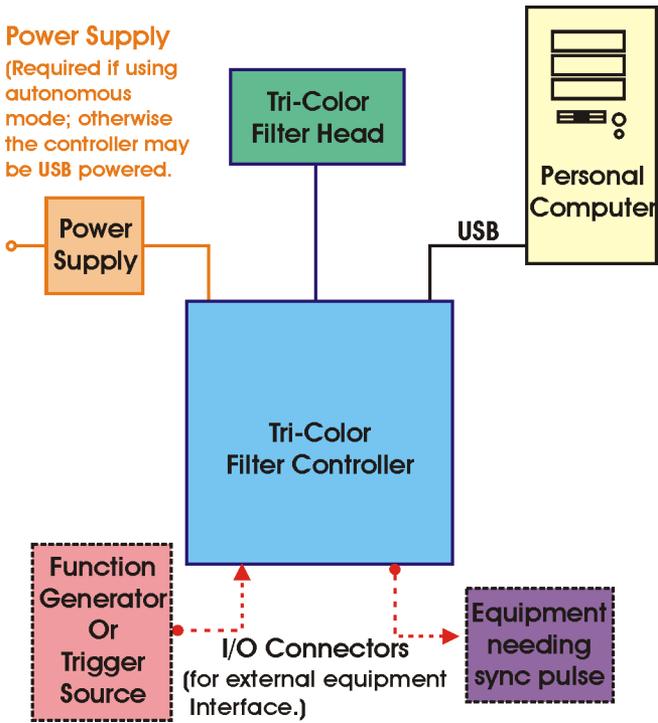
Figure 1 – Block diagram showing Tri-Color Filter's connections and control options.

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1. Hardware Setup and Configuration

1.1 Laboratory and computer requirements
- 100-240 VAC, 47-63 Hz 500 mA power if using autonomous mode
- A computer with an available USB port.
- Minimum computer system requirements to run the included ColorDRIVE 5000 software are 256 MB RAM, 250 MB hard drive space, 800x600 pixel, 16-bit color graphics display, a CD-ROM drive, and Microsoft® Windows® XP, Vista, Windows® 7 or Windows® 8.
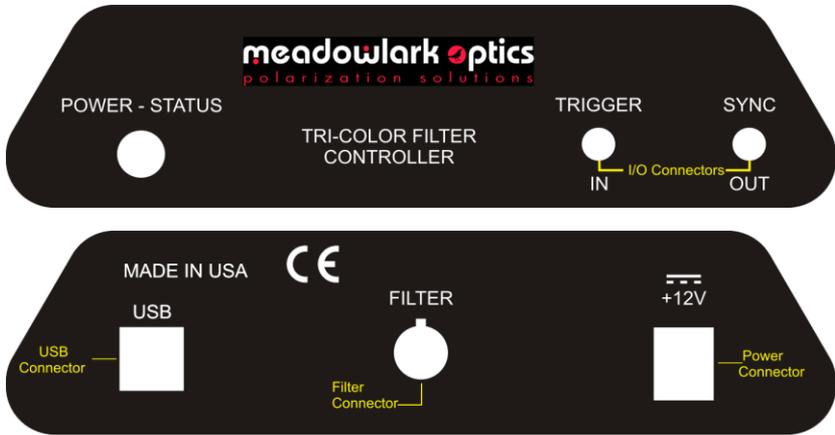
Figure 2 – Tri-Color Front and Back Panel Connections.

1.2 Using the digital controller
1. Unpack controller and cables from shipping container. Please verify that your shipment included:
   - Controller
   - Optical Head
   - +12V power supply and power cord
   - USB cable
   - ColorDRIVE software CD
   - User's manual

2. Install the ColorDRIVE 5000 software and USB driver.
   - Place the ColorDRIVE 5000 CD in the CD-ROM drive.

- A menu should automatically load. If not, open the CD in Windows Explorer and double click on the "AutorunCD5K.EXE" file. Please note that this file's icon is a picture of a CD.
- Click the "Install ColorDRIVE" button in the menu.
- Once ColorDRIVE is installed, the menu will re-load.

3. The USB driver must be installed prior to connecting the controller to the computer. The installers are located in the USB drivers directory of the CD, and can be installed via the Autorun menu. Please choose the 32 bit or 64 bit installer, as appropriate for your Windows® version. Windows® XP, Vista, 7 and 8 are all available in either 32 bit or 64 bit versions.

4. Hardware configuration of the controller:
- If using the external power supply, connect the +12VDC supply to the controller. Plug the power supply into a properly grounded AC outlet. Please note that the external power supply is required for use of the Tri-Color filter in autonomous mode.
- To use the USB interface, attach the USB cable to the USB connector on the rear of the controller and connect the other end to the USB port on the computer.
- Connect the Tri-Color optical head cable to the Filter connector on the rear of the controller.

5. Turn on the front panel power switch and observe the LED in the switch. The LED will initially illuminate **YELLOW**. The LED will then blink the firmware version in **GREEN** and then remain illuminated **GREEN** as long as the controller is powered on and no error has occurred. If an error has occurred, the LED will flash **RED**. It will flash **RED** and return to **GREEN** when the controller receives a USB command.

2. Computer Control

There are several computer-based methods by which to control the Tri-Color filter.

The most common methods of interfacing to the controller are:

1. Using the ColorDRIVE filter driver software package from Meadowlark Optics
2. Using the external input capability (Must be configured in ColorDRIVE)
3. Using a C/C++ program that communicates with the controller via USB
4. Developing a custom LabVIEW™ application using sub-VIs included on the ColorDRIVE CD.

2.1 ColorDRIVE Software

ColorDRIVE provides for manual, automatic and triggered state changes. It also allows configuration of states for automatic switching. Clicking the Meadowlark Optics logo at the top left of the user interface displays the software and firmware version numbers.

Figure 3 – **ColorDRIVE User Interface.**

2.1.1 Control Panel

Along the top of the control section are buttons and indicators that operate as follows:

- **Status Light:** Above Controller menu button, illuminates as shown below (also see Port Test below):

GREEN	Port status OK when last checked
YELLOW	User-initiated port test underway
RED	Last user-initiated port test failed

- **Controller *n*:** Pull Down menu to select between multiple controllers connected to the same computer.

- **Port Test:** Initiates a read/write test of controller. The status light illuminates **YELLOW** during the test, then **GREEN** or **RED** upon completion. A **GREEN** light indicates proper communication between the controller and the computer and a **RED** light indicates a communication issue between the controller and computer.
  In the event of a **RED** light:
    1. Check the cable connections.
    2. Exit ColorDRIVE, turn the controller off and back on, wait for the LED on the controller to stop flashing, then restart ColorDRIVE.
    3. Try a different USB cable.
    4. Try running the unit with a different computer.
    5. If all else fails, contact Meadowlark Optics for assistance.
- **Exit ColorDRIVE:** Quits ColorDRIVE. The last configuration selected in ColorDRIVE will be used by the controller until the controller is powered off. Please note that when the controller is powered back on, it will continue operating in the configuration it was in when powered off. If it was cycling states, the controller will start with the first valid state and continue cycling states in the same way it was before. If a state was manually selected, the filter will start in the first valid state, and remain there until changed.

- **Manual Tab:** This tab allows manual control of the tri-color filter's state. Selectable states are red, green, blue and on equipped filters, pseudo-white.

- **Cycle Tab:** This tab allows selection of the various methods by which states may be cycled automatically. These methods include:

  o Cycling automatically through the red, green and blue states, with the time in each state controlled by values stored in the controller. See the configuration tab information for more details. If a state's time is set to zero, it is skipped.

  o Cycling automatically through all valid states. A valid state is one with a non-zero time value. As with the above mode, the time in each state is controlled by values stored within the controller.

  o Cycling through the red, green and blue states, changing states only when a pulse is seen at the Trigger In connector on the front panel.

  o Cycling through all valid states, changing states only when a pulse is seen at the Trigger In connector on the front panel.

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o Randomly cycling through the red, green and blue states. The time the filter stays in each state is the same for all states, and is specified when this mode is selected in the software. The time may be set to values from 100 – 65535 milliseconds.

- **Configuration Tab:** This tab has controls which allow copying states, configuring timing for states and configuring sync pulse duration for modes that output a sync pulse. These controls are:

    o Copy States. This set of controls allows copyiing of the red, green, blue, and if equipped, white, states to the remaining 12 or 13 states the controller can store. By copying the states, the user has the ability to configure the controller to switch through a fixed order of states.

    o State Time. This control allows changing of the stored time for a given state. This controls how long the filter stays in the given state when automatically cycling. Valid state times are 1-65535 seconds.

    o Sync pulse duration. Auto cycling (non-triggered) modes can output a pulse when the state changes. This control allows controlling the duration of this pulse, with allowed pulse durations of 10-1000 microseconds. The pulse may also be turned off.

2.2 Additional Digital Interface Control Options

There are other digital interface control options: user created program to communicate with the controller via USB, or by using custom LabVIEW VIs supplied by Meadowlark Optics. Table 2 details a complete list of ASCII firmware commands that may be used when performing USB or HyperTerminal control. Note that all commands are lower case.

2.2.1 USB Control via C / C++ program

The user can write a program that communicates directly with the controller through a USB connection. Included on the ColorDRIVE CD (Source Code folder) is a source code file (usb_ver.cpp) that initializes a USB connection to the controller, sends a *ver:?* command and reads the status response (after sending any command, status must be read before another command can be sent). This program may be used as a starting point and modified as necessary to perform the desired task(s). Header file usbdrvd.h must be included in the source code and either the library file usbdrvd.dll or usbdrvd.lib (all included on the ColorDRIVE CD) must be linked in the final program. The sample code uses usbdrvd.dll; however some compilers will require the usbdrvd.lib file. If a

user developed or modified application program is to be distributed in any way, please contact Meadowlark Optics for licensing and copyright details.

2.2.2 ASCII Commands

The Tri-color Filter's available ASCII commands are summarized in Table 1. These commands are useful for extending the LabVIEW examples described in section 3.3.3 or writing software in C or C++, or in other languages that can interface with the included usbdrvd.dll. Please note that Meadowlark Optics is unable to give programming support.

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Table 1 – ASCII commands for the Tri-Color Filter Controller

Firmware Command	Description	Notes
copyst:*m,n*	Copies one of the first 3 or 4 (red, green, blue, white) states to one of the remaining states.	*m* = state to copy from (1-3 or 4) *n* = state to copy to (4 or 5 to 16)
cyc:*n*	Tells the Tri-Color filter to cycle through the first 3 or 4 states or to stop cycling. Time for each state is set via the stt: command and must be set before using this command.	*n* = 0 or 1. 1 starts cycling and 0 stops cycling.* Only states with a valid time (set with the stt command) will be included in the cycle. If configured with the syncd command, a sync pulse will be output on state change.
cycl:*n*	Same as the cyc command except cycles through all valid states.	Same as the cyc command, but cycles through all valid states.
cycp:*n*	Tells the Tri-Color filter to cycle through the first 3 or 4 states or to stop cycling. State change occurs only when a trigger pulse is detected on the controller's trigger input.	*n* = 0 or 1. 1 starts cycling and 0 stops cycling.* Only states with a valid time (set with the stt command) will be included in the cycle.
cyclp:*n*	Same as the cycp command, except cycles through all valid states.	Same as the cycp command, except cycles through all valid states.
cycm:?	Queries the current operating mode of the filter. Result indicates command being executed.	Controller returns an integer indicating current mode. These are: 1 = constant state; 2 = cyc; 3 = cycl; 4 = cycp; 5 = cyclp; 6 = rand.
rand:*n*	Tells the Tri-Color filter to cycle randomly through the first 3 states or to stop cycling.	*n* = time to remain in each state (milliseconds). Valid range is 10-65535 milliseconds. A value of 0 stops cycling. If configured with the syncd command, a sync pulse will be output on state change.
rand:?	Queries the current state wait time for random cycling.	Controller returns wait time in milliseconds.
syncd:*n*	Sets the sync pulse duration for the cyc, cycl and rand commands.	*n* = pulse duration in microseconds (9 – 1000). Sync is off for values less than 10 microseconds.
syncd:?	Queries the sync pulse duration.	Controller returns pulse duration in microseconds.
state:*n*	Tells the Tri-color filter to go to state *n*.	*n* = state (1-16)
state:?	Query current state of the Tri-Color filter.	Controller returns current state number (1-16)
stt:*n,t*	Set delay time for a filter state. Used for timing with cyc and cycl commands and for validation with other commands.	*n* = state (1-16) *t* = delay time (0-65535 milliseconds). Setting *t* disables the state.
stt:*n*,?	Query delay time for state *n*.	*n* = state (1-16). Controller returns delay time in milliseconds.
ver:?<CR>	Query firmware version.	Controller returns firmware version and copyright string

*-sending any command where 0 stops cycling will stop cycling, regardless of which command started the cycling.

2.2.3 Custom LabVIEW VI Control

An example VI and a LabVIEW library file are included on the ColorDRIVE CD in the LabVIEW folder.

These include:
- Meadowlark USB IO Example Manual Switching.VI – Shows how to manually switch the Tri-Color Filter's state.
- Meadowlark USB IO Example Cycling.VI – Shows how to select the Tri-Color Filter's different state cycling modes.
- Meadowlark USB.LLB:
    - Meadowlark USB COM.vi – Allows sending ASCII commands to the controller and reading its responses to these commands.
    - Meadowlark USB Cycle Random.vi – Tells the controller to start randomly cycling between the first three filter states.
    - Meadowlark USB Easy Open.vi – Allows opening of a USB connection to the controller.
    - Meadowlark USB Easy Close.vi – Closes the USB connection to the controller.
    - Meadowlark USB Get Configuration.vi – Reads the configuration of the tri-color filter and places it in the below global variable.
    - Meadowlark USB Tricolor Config.vi – A global variable holding the current configuration of the tri-color filter.
    - Meadowlark USB Tricolor State.vi – Used to set the tri-color filter to one of its states when programmatically switching states.

The sample VIs include a LabVIEW library file containing fundamental VIs and two examplse that implement them. The first example (Meadowlark USB IO Example Manual Switching) shows how to programmatically set the Tri-Color TOF to a particular state. The second program shows how to query the Tri-Color TOF's current operating mode and how to programmatically tell the filter to use various cycling modes. The LabVIEW back panel of both *IO Example* VIs is user accessible to facilitate independent development. Programmers are encouraged to open and examine the *IO Examples'* diagram screens. Please note that the LabVIEW development suite, version 2010 or newer, from National Instruments is required to use the included VIs, and is not provided with any version of ColorDRIVE software. It is assumed that the customer has experience programming in LabVIEW and understands good programming practices. Meadowlark Optics cannot offer customer support for LabVIEW application development. If a developed or modified LabVIEW application is to be distributed in any way, please contact Meadowlark Optics for licensing and copyright details.

3. Frequently Asked Questions

Q: The controller is not working. What should I check?

A: Make sure the power supply is plugged in, front panel switch is on and the green power light is steady. If using a USB interface, check the status of the controller under Windows® Device Manager by looking for a Meadowlark Optics Tri-Color Filter Controller. Occasionally it helps to turn off the controller, wait a few seconds, and then turn it back on.

Q: I started the ColorDRIVE software and then turned on the controller, and now the software is behaving erratically. What is happening?

A: The controller must be turned on and have completed its power-on self-test _before_ starting the ColorDRIVE software.

Q: I need a particular sequence of states for my application. How do I do this?

A: Develop code using LabVIEW™ development suite and VIs included on the ColorDRIVE CD. Alternatively, the C code example included on the CD may be used to develop code to output the necessary sequence. Additionally, the controller can store up to 13 states beyond the default R,G, B states. Timing for these states is individually programmable, and then the various cycling commands may be used.

Q: How do I uninstall the ColorDRIVE software?

A: Use the Add/Remove Programs option in the Windows® control panel.

Q: What is the power-on default operating mode?

A: The controller will remember its previous settings.

Q: The LED on the controller is currently blinking **RED**. What does this mean, and what should I do?

A: There has been an internal error. Try turning the controller off and back on. If the controller does not return to normal operation, contact Meadowlark Optics for assistance.

Appendix A: Firmware Updater

The user can reprogram the internal firmware when new versions are released. Update is accomplished by using the firmware updater program included on the ColorDRIVE CD. In order to use the firmware updater program, the controller must be powered on and connected to an available USB port on the host computer.

Perform the following steps to reprogram the controller firmware:

1. Install firmware updater software on a computer running Microsoft® Windows® (XP or later).   Place ColorDRIVE CD in the CD-ROM drive, wait for the CD menu to appear and click on the "Install Firmware Updater" button.

2. Start the firmware updater software by clicking Start➔Programs➔Meadowlark Optics➔Firmware updater. The following screen will appear:
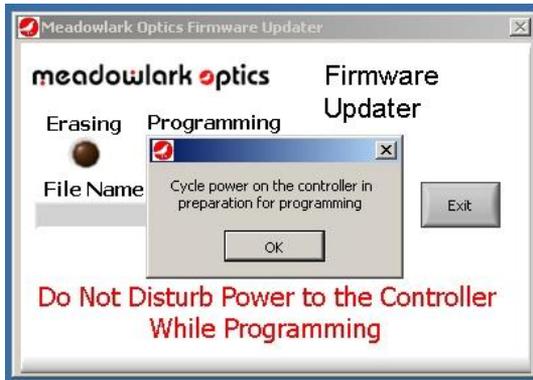
3. Cycle power on the controller to ensure the USB connection is properly made. Wait until the front panel status LED is done flashing before clicking OK. If the power is not cycled or the OK button is clicked before the front panel status LED is done flashing, the following error will be displayed. If this error appears, close the firmware updater program and re-run it.
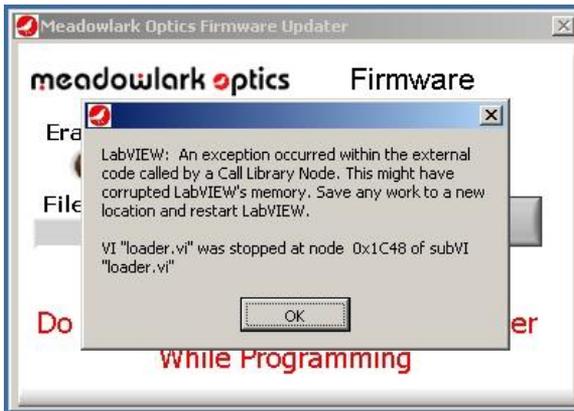
4. The following screen will appear after the USB connection is made.
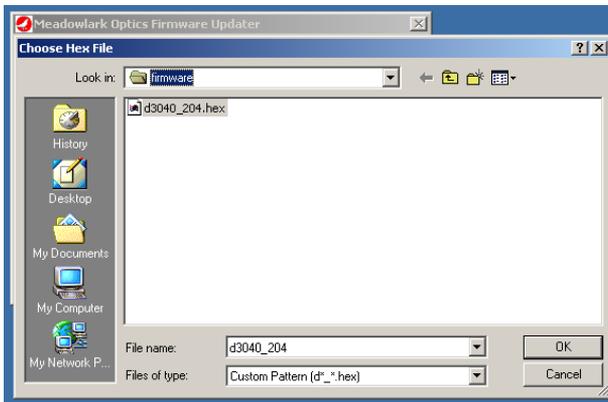
5. Choose the new hex file and click "OK". The program will check if the new firmware file is valid for the controller. If not, the following error screen will appear. At this point the user may elect to choose a different file or go ahead and program the controller with the chosen file.

   Extreme caution should be exercised when deciding whether to program the controller with a file that may not be compatible, as the controller may become non-functional. If there are questions about choosing the appropriate file, please contact Meadowlark Optics at 303-833-4333.
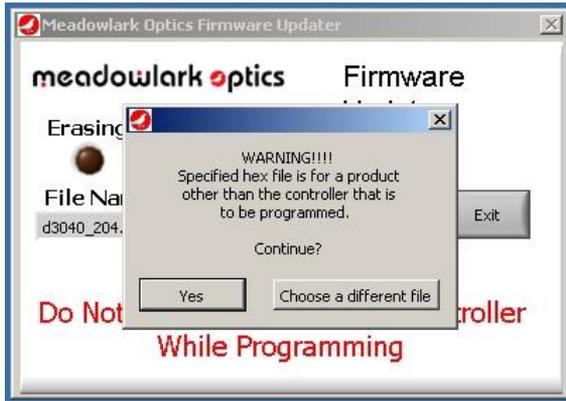
6. After the hex file is loaded and passes validity tests, the ready screen appears. Click the Program button to reprogram the controller firmware. If a final check is desired before reprogramming the firmware, the Meadowlark Optics logo may be clicked to display a screen showing the old and new firmware versions.

7. As the firmware is being erased and reprogrammed the status will be displayed as shown. *DO NOT* **disturb power to the controller while it is erasing or reprogramming.** If power is disturbed the controller's memory will be corrupted, requiring the unit to be returned to Meadowlark Optics for reprogramming.

8. After programming is complete, the following screen appears. When the controller power is cycled, the status light should flash a pattern corresponding to the version number of the new firmware. The new firmware version may also be determined by clicking the Meadowlark Optics logo in the upper left corner of ColorDRIVE.
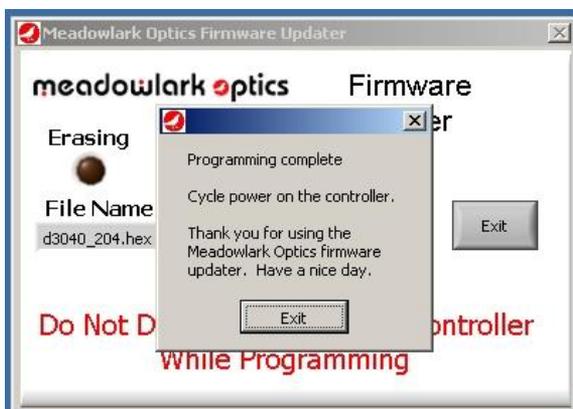
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5964 Iris Parkway
P.O. Box 1000 (US Mail)
Frederick, Colorado 80530
303-833-4333

sales@meadowlark.com
www.meadowlark.com